Correlation between mask compliance and COVID-19 outcomes in Europe

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ABSTRACT

The COVID-19 pandemic has introduced the use of face masks as a tool to curb viral transmission among potential susceptible persons at an unprecedented global scale. Here, I analyse the impact of mask usage on COVID-19 cases and mortality throughout Europe in the fall and winter of 2020-2021. Surprisingly, weak to moderate positive correlations between mask compliance and cases and between mask compliance and mortality have been revealed.

Face masks still are one of the most significant and controversial symbols in the fight against COVID-19. Two large randomised controlled trials about mask effectiveness performed during the pandemic came out with mixed results [1, 2]. Several studies that analysed the effect of masks on the general population (ecological studies) have came to the conclusion that masks were associated with a reduction in transmission and cases [3, 4, 5, 6, 7]. However, these studies were restricted to the summer and early autumn of 2020.

From March 2020 onwards country after country instituted some sort of mask mandate or recommendation. The stringency of these measures varied among the different countries and they therefore resulted in different proportions of mask compliance,

ranging from 5% to 95% [8]. Here, I step up the data on mask usage against the number of cases (per million) and deaths (per million) from October 2020 to March 2021 in 35 European countries (Table S1) . For this analysis all European countries with more than one million inhabitants were selected, encompassing a total of 602 million people. All analysed countries underwent a peak of COVID-19 infections during this 6-month period (Figure S1). The average proportion of mask usage in the referred period was $60.9\% \pm 19.9\%$, slightly higher in Eastern than in Western Europe (62.1% and 59.6%, respectively). However, the level of mask compliance was considerably more homogeneous among East Europe countries (SD = 13.4%) than among West Europe countries (SD = 25.4%). Surprisingly,weak positive correlations were observed when mask compliance was plotted against cases/million or deaths/million (Figure 1).
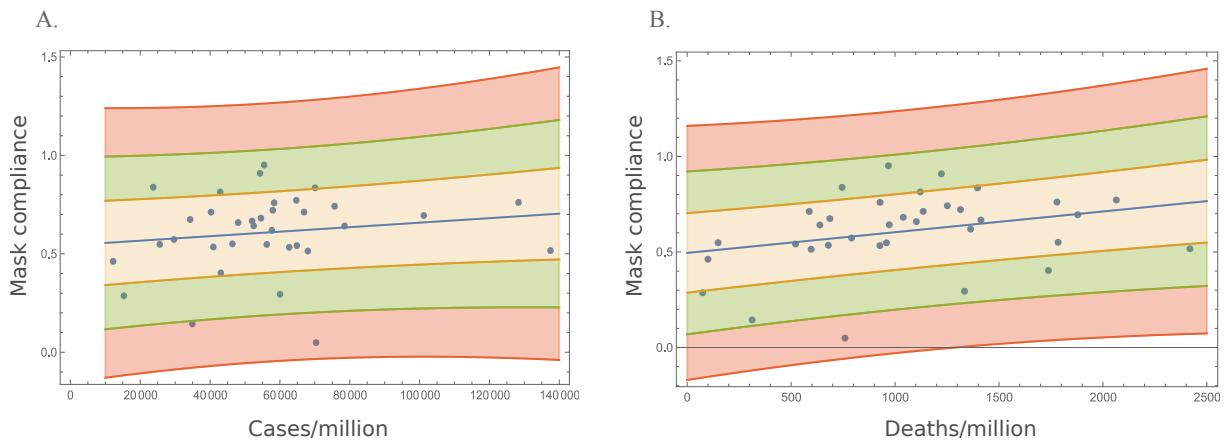

Fig 1. Correlation between average mask compliance and cases/million (A) or deaths/million (B) in 35 European countries. Each dot represents a country. The blue line represents the fitted regression line and the areas above and below indicate 1 σ (yellow), 2 σ (green) or 3 σ (red).

Neither the number of cases nor the proportion of mask usage followed a Gaussian distribution (Shapiro-Wilk p-values were 0.004 and 0.0536, respectively). A Spearman's rank test was applied to quantify the correlation between mask usage, cases and deaths

(Table 1) .

Table 1. Spearman's rank correlation coefficient
between mask usage and COVID-19 cases and deaths.

Territory	Masks x Cases	Masks x Deaths
All Europe	0.14	0.36
Eastern Europe [1]	0.18	0.20
Western Europe [2]	0.11	0.60

[1] Albania, Bosnia and Herzegovina, Bulgaria,
Croatia, Czechia, Hungary, North Macedonia,
Poland, Romania, Serbia, Slovakia, Slovenia,
Belarus, Estonia, Latvia, Lithuania, Republic of
Moldova, Ukraine

[2] Austria, Belgium, Denmark, Finland, France,
Germany, Greece, Ireland, Italy, Netherlands,
Norway, Portugal, Spain, Sweden, Switzerland,
United Kingdom, Northern Ireland

As expected, positive correlation coefficients between mask usage and cases (Spearman's correlation coefficient = 0.14) or between mask usage and deaths (Spearman's correlation coefficient = 0.36) were found. The correlation between masks and deaths was considerably higher in the West than in East European countries: 0.60 and 0.20, respectively. This could be related to the fact that the most populous European countries are located in the west. However, the correlations did not significantly change when the 7 countries with populations > 20 million were excluded from the analysis (Spearman's coefficient for cases = 0.16; Spearman's coefficient for deaths = 0.40).

While no cause-effect pattern could be inferred from this observational analysis, the positive correlation between mask compliance and COVID-19 cases and deaths in

the European continent for a 6-month period indicates that masks were ineffective in curbing COVID-19 spread. Moreover, the relatively strong positive correlation between mask usage and deaths suggests that the universal use of masks may have harmful unintended consequences.

All data was retrieved from [8] on 14$^{\text{th}}$ February 2022. IHME mask data sources: The Delphi Group at Carnegie Mellon University and University of Maryland COVID-19 Trends and Impact Surveys, in partnership with Facebook; Kaiser Family Foundation; YouGov COVID-19 Behaviour Tracker survey. Spearman's correlation analyses were in Libreoffice Calc (v. 7.2.4.1), Shapiro-Wilk normality checks were in JASP (v. 0.15) and linear regression in Wolfram Mathematica 13.0.

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Table S1

Table S1. Proportion of mask usage and number of COVID-19 cases and deaths per million from 1st October 2020 to 31th March 2021 in Europe.

Country	Mask usage[1]	Cases/million	Deaths/million
Albania	53%	40990	679
Bosnia and Herzegovina	40%	43078	1738
Bulgaria	55%	46405	1784
Croatia	29%	60039	1334
Czechia	52%	137494	2418
Hungary	77%	64704	2064
North Macedonia	67%	52048	1413
Poland	72%	57966	1315
Romania	81%	42898	1121
Serbia	54%	64829	521
Slovakia	76%	128326	1779
Slovenia	69%	101198	1879
Belarus	55%	25595	149
Estonia	64%	78525	639
Latvia	64%	52493	972
Lithuania	74%	75664	1252
Republic of Moldova	66%	48045	1102
Ukraine	67%	34298	686
Austria	55%	56237	959
Belgium	71%	66905	1135
Denmark	14%	34942	312
Finland	46%	12252	100
France	76%	58354	928
Germany	57%	29671	791
Greece	84%	23722	745

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[1]Percent of population reporting always wearing a mask when leaving home

Ireland	71%	40270	587
Italy	91%	54310	1223
Netherlands	51%	68009	596
Norway	29%	15340	75
Portugal	84%	70056	1397
Spain	95%	55480	968
Sweden	5%	70356	759
Switzerland	53%	62669	927
United Kingdom	62%	57689	1363
Northern Ireland	68%	54567	1039
Shapiro-Wilk p-value [2]	0.056	0.004	0.693

[2]Shapiro-Wilk test for normality

Figure S1

A.
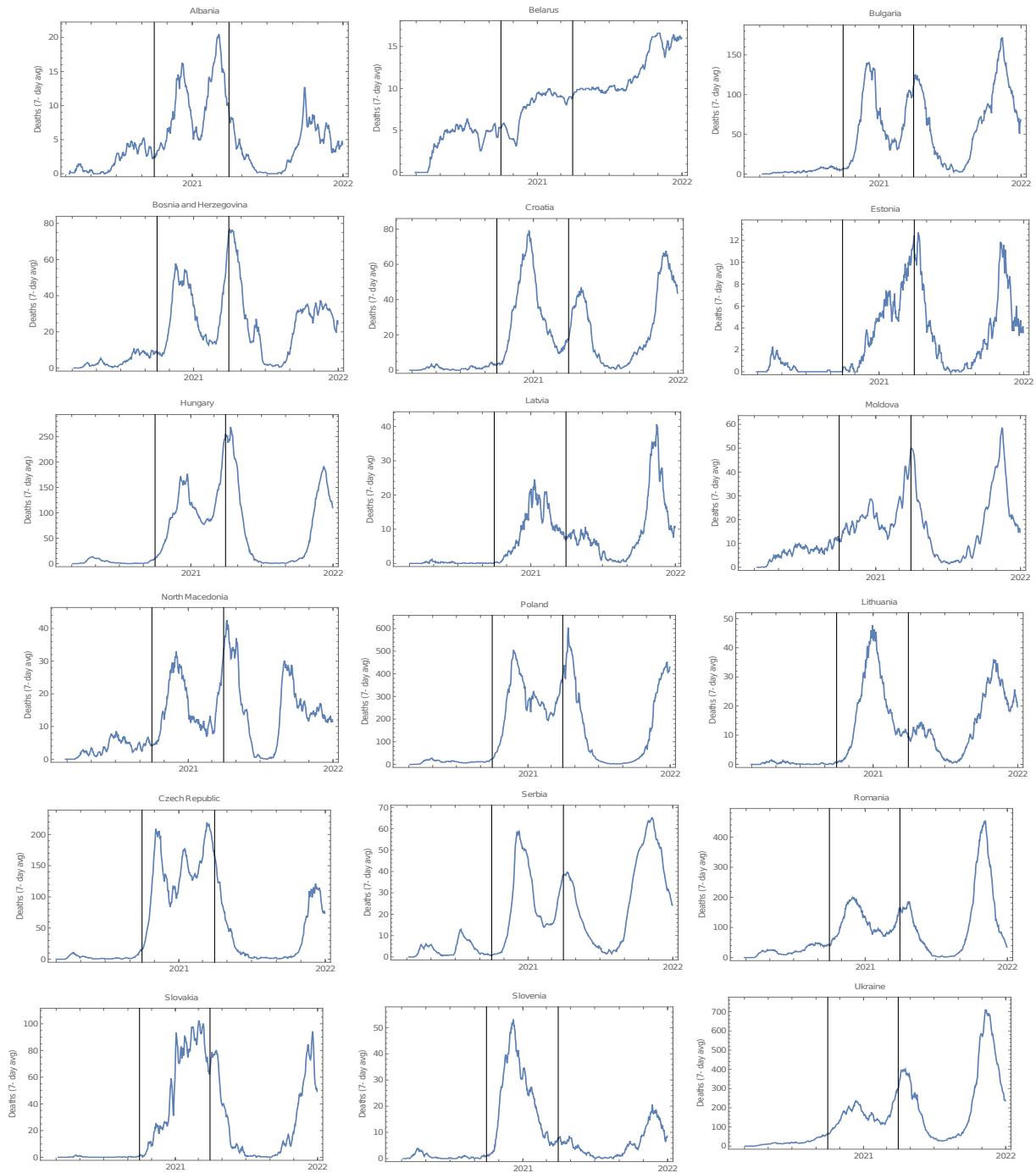
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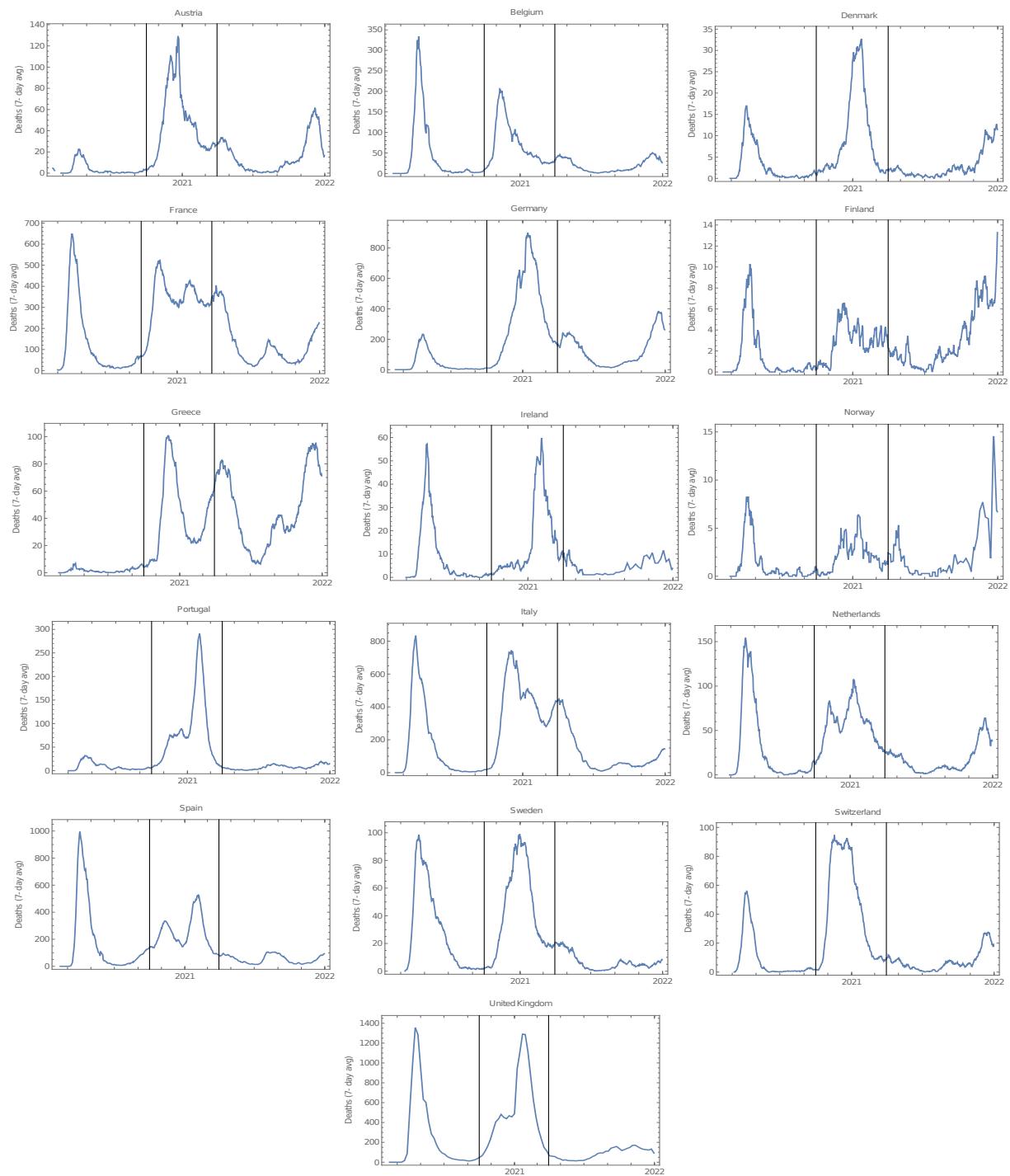
Fig S1. Mortality from COVID-19 throughout the pandemic in (A) Eastern European countries and (B) Western European countries. The area between vertical black bars corresponds to the period analysed in this study (01.10.2020 to 31.03.2021). Data was downloaded on 14.02.2022 from IHME.